(b) **Agricultural Liming Material.** This material shall consist of either agricultural limestone or hydrated lime and shall meet the requirements of Section 706. When agricultural limestone is called for, 70 pounds (kg) of hydrated lime may be substituted for 100 pounds (kg) of agriculture limestone. Agriculture limestone shall not be substituted for hydrated lime.

Liming material furnished in standard factory-sealed containers shall have all labeling required by the Oklahoma Agricultural Liming Materials Act intact and legible until the contents are used.

Each vehicle load of liming material furnished in bulk form shall be accompanied by two legible copies of the purchase receipt. This receipt shall be given to the Engineer upon delivery of the liming material. Each receipt shall include the following: the name of the liming material, the brand or trade name, the net mass, the percent ECCE (Effective Calcium Carbonate Equivalent), and the name and address of the manufacturer, producer, or distributor.

The Engineer will obtain a one quart (liter) sample from each vehicle load of bulk material to be submitted to the Materials Laboratory for testing.

735.08. TEMPORARY SILT DIKE MATERIALS.

Temporary silt dike shall be triangular shaped, having a height of at least 8-10 inches (200-250 mm) in the center with equal sides and a 16-20 inch (400-500 mm) base. The outer cover shall be a woven geotextile fabric placed around the inner material and allowed to extend beyond both sides of the triangle 24-36 inches (600-900 mm). The geotextile fabric shall be mildew resistant, rot-proof and resistant and ultraviolet radiation meeting the requirements for temporary silt fence in AASHTO M288-97. The edges shall be treated to prevent unraveling. Seams and stress points shall be reinforced. The fabric cover and apron shall be a continuous wrapping of the fabric: the apron shall be a continuous extension of the upstream face. The urethane foam used as the inner layer of the silt dike shall meet the requirements for ASTM D3574.

SECTION 736
PAVEMENT MARKERS

736.01. CLASS A REFLECTIVE PAVEMENT MARKERS.

(a) **Design and Shape.** The prismatic reflectorized marker shall conform to the shape and dimensions shown on the Plans and shall be so constructed that moisture and road grime will not penetrate or damage the element. Reflector units shall be smooth throughout and made of methylmethacrylate conforming to the requirements of Standard Specifications for Methacrylate Molding and Extrusion Compounds ASTM D 788. Grade 8 shall be used unless otherwise specified. The reflector shall show no change in shape or color when subjected to the requirements of Test Method OHD-L-24 at a temperature of 140°F (60°C) with the marker in the vertical position.

The marker shall be molded of methylmethacrylate conforming to Federal Specification L-P-380a, Type 1, Class 3. Filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass the necessary physical requirements. The marker shall withstand a load of 9000 pounds (40.0 kN) without breaking or being significantly deformed when tested according to Test Method OHD-L-23.

(b) **Reflector.** Horizontal incidence angle means the angle, in a plane parallel to the base of the marker, between a line in the direction of the incident light and a line perpendicular to the leading edge of the reflective surface.

Divergence angle means the angle at the reflector between observer's line of sight and the direction of the light incident on the marker. Specific intensity shall mean candela of the returned light at the chosen divergence and incidence angle for each lux of incident light. Federal Test Method Standard 370 will be used to determine specific intensity.

The specific intensity of the reflector at 0.2° divergence angle shall not be less than the following when the incident light is parallel to the base of the marker:

Horizontal Entrance Angle,	Specific Intensity, mcd/lux		
degrees	Crystal	Amber	Red
0	232	139	56
20	93	56	19

(c) **Sampling and Testing.** A minimum of five pavement markers of each type to be used on the project, selected at random by the Engineer, shall constitute a sample. Testing shall be in accordance with testing procedures indicated in this Specification.

736.02. CLASS B NONREFLECTIVE PAVEMENT MARKERS.

(a) **Design and Shape.** Traffic Buttons shall be round and dome shaped with a uniform curvature. The top and sides of the buttons shall be smooth and free from surface irregularities, pits, cracks, checks, chipping, discoloration, and any other defects which adversely affect appearance and application. The bottom of the buttons shall be rough-textured, free from gloss, glaze or any other substances that may reduce its bond to the adhesive.

Each traffic button shall be 4 ± 1/8 inch (101.6 ± 3.2 mm) in diameter at the base. Height of the button shall be 11/16± 1/16 inch (17.5 ± 1.6 mm). The base of the button shall not deviate from a flat plane by more than 1/16 inch (1.6 mm).

(b) **Physical Requirements.** The water absorption of the button shall not exceed 1.0 percent of the original dry mass when tested in accordance with ASTM C 373.

The glazed surface of the button shall not craze, spall, or peel when subjected to one cycle of the autoclave test at 250 psi (1.72 MPa) in accordance with ASTM C 424.

A random sample of 5 buttons shall be subjected to the compressive load test. The average compressive strength of the 5 buttons shall not be less than 1500 pounds (6.67 kN), and no individual button shall have a compressive strength less than 1200 pounds (5.34 kN).

The button shall be centered, base down, over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1 inch (25.4 mm) high with an internal diameter of 3 inches (76.2 mm) and a wall thickness of 1/4 inch (6.4 mm). A load necessary to break the button shall be applied at a speed of 0.2 inch (5.1mm) per minute to the top of the button through a 1 inch (25.4 mm) diameter solid metal cylinder centered on the top of the button. Should any of the samples tested for strength fail to comply with this Specification, 10 additional samples will be tested. The

failure of any one of the resamples shall be cause for rejection of the entire lot or shipment represented by the samples.

The button shall not break, chip, or crack when subjected to the impact of a 1 pound (454 g) steel ball falling freely from a height of 24 inches (610 mm). Impact tests shall be performed at a temperature of 40°F to 45°F (4.4 to 7.2°C) with the button resting on but not bonded to a flat steel plate. Buttons shall be heat-aged a minimum of 10 days at 150°F (65.6°C) before testing for impact resistance.

(c) **Color.** The color of the buttons shall be as designated on the Plans, shall be uniform, and shall be determined by visual comparison with calibrated standards having C.I.E. Chromaticity Coordinate limits determined in accordance with Federal Test Method TT-T-141, Method 4252 falling within an area having the following corner points:

	1		2		3		4		Brightness
	X	Y	X	Y	X	Y	X	Y	(% MgO)
White	.290	.316	.310	.296	.330	.321	.310	.342	80 min.
Yellow	.470	.460	.515	.485	.545	.455	.490	.425	40 min.

(d) **Glaze Thickness.** The glazed surface shall have a mean thickness not less than 0.005 inch (125 µm) when measured not closer than 1/4 inch (6.4 mm) from the edge of the button. The glaze thickness shall be measured on a fractured edge of the button to the nearest 0.001 inch (25 µm) by a calibrated scale microscope.

(e) **Sampling and Testing.** A minimum of ten traffic buttons selected at random by the Engineer will constitute a sample. Samples will be forwarded to the Materials Division for testing.

736.03. CLASS C REFLECTIVE ALL- WEATHER PAVEMENT MARKERS.

(a) **Design and Shape.** Pavement markers shall consist of an iron casting to which are attached replaceable prismatic reflectors of the type shown on the Plans and as further described in these Specifications. The forward portion(s) of the casting shall be so shaped that the blade of a snowplow, maintainer, or other highway maintenance equipment will be deflected without snagging or damaging the marker. The bottom of the casting shall incorporate anchoring devices designed to fit into slots or grooves cut in the roadway surface. The marker shall be bonded to the roadway pavement with an approved adhesive. It shall be anchored so that the marker will not be dislodged by traffic, snowplows, or other highway maintenance equipment. Design the casting so that the reflector-mounting surface will be 30° to the horizontal and contain provisions for securely attaching replaceable reflectors. Make provisions for fast, easy replacement of reflectors with common handtools without disturbing the anchorage of the casting. The marker shall withstand a load of 9000 pounds (40.0 kN) without breaking or being significantly deformed when tested according to test method OHD L-23.

(b) **Casting.** The casting of the marker shall conform to the shape and dimensions shown on the Plans and shall be a clean, substantial casting, free from sand or blow holes or other defects. The surface of the castings shall be free from burnt-on sand and shall be reasonably smooth. Runners, risers,

fins, and other cast-on pieces shall be removed from the casting and such areas ground smooth. All corners and edges exposed to traffic shall be rounded. Casting shall be made of ductile iron and shall conform to the requirements of ASTM A 536. Grade 65-45-12 shall be used unless otherwise specified. The top of the forward rails of the casting shall have a hardness of 50-55 RC when tested by ASTM E18.

(c) **Reflector.** The reflectors of the marker shall conform to the shape and dimensions shown on the Plans and shall be so constructed that moisture and road grime will not penetrate or damage the element. Reflector units shall be smooth throughout and made of methylmethacrylate conforming to the requirements of ASTM D 788. Grade 8 shall be used unless otherwise specified.

The reflector shall show no change in shape or color when subjected to the requirements of test method OHD-L-24. The temperature shall be 140°F (60°C) with the marker in a vertical position.

The specific intensity of the reflector shall meet the requirements of Subsection 736.01(b).

(d) **Sampling and Testing.** Sampling and testing shall be in accordance with Subsection 736.01(c).

736.04. ADHESIVES FOR USE WITH PAVEMENT MARKERS.

(a) **Epoxy Resin Adhesives.** Epoxy resin adhesives used for securing Class A and Class B pavement markers to the roadway surface shall meet the requirements of AASHTO M 237. The epoxy resin adhesives used for securing Class C pavement markers shall meet the requirements of AASHTO M 237 except the viscosity may be lower in accordance with the pavement marker manufacturer's recommendation.

(b) **Bituminous Type Hot-Melt Adhesives.** This item establishes the requirements for Bituminous Type Hot-Melt Adhesive used for securing the Class A and Class B Construction Zone Pavement Markers and Tube Channelizers to the roadway surface:

1. *Description.* The adhesive shall be suitable for bonding ceramic and plastic markers to Portland Cement Concrete, Asphaltic Concrete, and chip-sealed road surfaces–and applicable when road surface and marker temperatures are in the range of 40°F to 160°F (4°C to 70°C). The composition of the adhesive must be such that its properties will not deteriorate when heated to and applied at temperatures up to 430°F (220°C) using either air or oil-jacketed melters.
2. *Materials.* The adhesive shall be an asphalt material with a homogeneously mixed mineral filler and shall comply with the following requirements:

ADHESIVE PROPERTIES:

Property	Min	Max	Method
Softening Point, °F (EC)	200 (93.3)	-	ASTM D 36
Penetration	10	20	ASTM D 5
Flow, inches (mm)	-	0.2 (5.1)	ASTM D 3407, As Modified in Test Methods
Heat Stability flow, inches (mm)	-	0.2 (5.1)	As in Test Methods
Viscosity, 400°F (204.4EC), Pa•s	-	7.5	ASTM D 2669, As Modified in Test Methods
Flash Point, C.O.C., °F (EC)	500 (260)	-	ASTM D 92

Asphalt properties determined on the filler-free-material derived from the extraction and Abson recovery process as explained in the test methods:

Property	Min	Max	Method
Penetration, 100 G. 5 Sec. 77°F (25EC)	25	-	ASTM D 5
Viscosity, 275°F (135EC), Pa•s	1.2	-	ASTM D 2171
Viscosity Ratio, 275°F (135EC)	-	2.2	As Explained in Test Methods

Filler properties determined using the filler separation technique described in test methods:

Property	Min	Max	Method
Filler Content, %	50	75	As in Test Methods
Filler Fineness, %			ASTM C 430, As
45 µm	75	-	Modified in Test
75 µm	95	-	Methods
150 µm	100	-	

3. *Test Methods.*

3.1. Flow shall be determined according to Section 6, Flow of ASTM D 3407 with the exception that the oven temperature shall be 158°F ± 2°F (70 ± 1°C) and sample preparation shall be according to Section 7.1 of ASTM D 5.

3.2. Heat stability flow shall be determined according to flow with the exception that 2 pounds (1000 g) of adhesive shall be placed in a covered liter can, heated to 430°F (220°C), and maintained at this temperature for four hours prior to preparing the sample panel.

3.3. Viscosity is to be determined according to ASTM D 2669 using a spindle speed of 1.88 rad/s. The adhesive shall be heated to approximately 210°C and allowed to cool. Viscosity shall be determined at 400°F ± 1°F (204.4 ± 0.6°C).

3.4. Properties of the base asphalt are to be determined on the material obtained from the following extraction and abson recovery methods. The asphalt shall be extracted by heating the adhesive just to the point where it will easily flow and then transferring 125 to 150 g into 400 ml of trichloroethylene with a temperature of 125°F to 150°F (52 to 66°C). This mixture shall be thoroughly stirred to dissolve the asphalt. The trichloroethylene-asphalt mixture shall be decanted and the asphalt shall be recovered using the abson recovery methods, ASTM D 1856 as modified by the following. The extraction methods of ASTM D 271s shall not apply and there shall be no filtration of the solvent-asphalt mixture. The extraction solution of the trichloroethylene and asphalt shall be centrifuged for at least 30 minutes at 770 times gravity in a batch centrifuge. Decant this solution into the distillation flask, taking care not to include any filler sediment. Apply heat and bubble carbon dioxide slowly to bring the solution temperature to 300°F (149°C). At this point, the carbon dioxide flow is increased to 800 to 900 ml per minute. The solution temperature is maintained at 320 to 335°F (160 to 168°C) with this carbon

dioxide flow rate for at least 20 minutes and until the trichloroethylene vapors have been completely removed from the distillation flask. Repeat the above extraction-recovery method as necessary to obtain the desired quantity of asphalt. Use the recovered asphalt to determine penetration, 275°F (135°C) viscosity, and 275°F (135°C) viscosity ratio.

3.5. The 275°F (135°C) viscosity ratio shall be determined by comparing the 275°F (135°C) viscosity on the base asphalt before and after the thin-film oven test. The thin-film oven test shall be performed as in ASTM D 1754. The specific gravity shall be determined by pycnometer as in ASTM D 70 for use in the thin-film oven test. The 275°F (135°C) viscosity ratio shall be calculated by dividing the viscosity after the thin-film oven test by the original 275°F (135°C) viscosity.

3.6. The filler material shall be separated from the asphalt to determine filler content and filler fineness. The portion by mass of the adhesive insoluble in trichloroethylene shall be considered the filler content. Filler content shall be determined by placing 10 ± 0.01 g of solid adhesive into centrifuge flask with approximately 100 ml volume such as that specified in ASTM D 1796. Add 50 ml of trichloroethylene to the adhesive, which should be broken up into small pieces in order to speed the dissolution process. Swirl or stir with a fine rod, taking care not to lose any solids, place the sample flask in a balanced centrifuge, and spin using a minimum relative centrifugal force of 150 (as determined in Section 6 of ASTM D 1796) for 10 minutes. Remove the sample flask, and decant the solvent, taking care not to lose any solids. Repeat the application of solvent and centrifuging until the solvent becomes clear and the filler is visually free of asphalt. Dry the filler at 160°F ± 5°F (71 ± 3°C) to remove solvent and determine the mass the resulting filler. Filtration of the decanted solvent may be performed to verify there is no loss of filler, percent filler content is calculated as follows:

$$\text{Filler Content, \%} = \frac{\text{Filler, g}}{\text{Original Adhesive, g}} \times 100$$

3.7. Filler fineness shall be determined according to ASTM C 430 using numbers 325, 200 and 100 (45, 75, and 150 µm) sieves. This method is to be modified by the use of a water-soluble non-toxic wetting agent, such as Triton X-100, to aid the wetting action. Concentration of the surfactant solution shall be approximately one percent by mass. The one-gram dry sample shall be thoroughly wetted in the surfactant solution and allowed to soak for 30 minutes. The filler shall be transferred completely into the sieve cup and waterspray applied for two minutes. Surfactant solution may be added as needed, and physical means may be used to disperse any clumped particles. The sample shall then be dried and handled as directed in ASTM C 430.

4. *Packaging and Labeling.* The adhesive shall be packaged in self-releasing cardboard containers which will stack properly. Containers shall have a maximum net mass of 120 pound (54.4 kg). The label shall show the manufacturer, quantity and lot or batch number. Bituminous adhesive for traffic markers shall be printed in bold lettering on the label.

(c) **Sampling and Testing.** Furnish a Type D certification for each batch or lot of the materials. In addition, submit a 1 gallon (4 liter) sample of each epoxy component and/or a minimum of 10 pounds (5 kg) of bituminous adhesive for each batch or lot to the Materials Engineer for testing.